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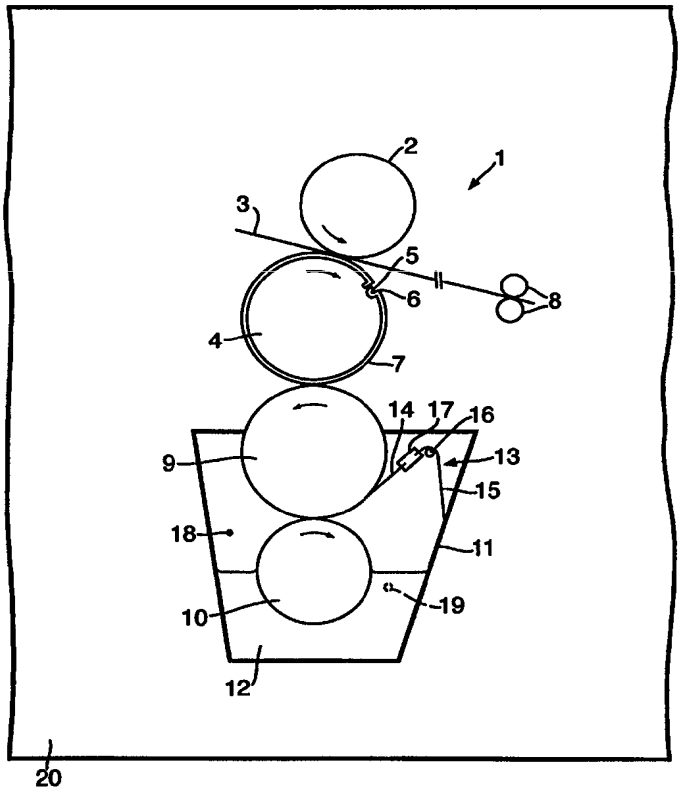
(54) Title: FLEXOGRAPHIC PRINTING ON SMOKING ARTICLE WEB MATERIAL

(57) Abstract

This invention relates to improved print quality on a smoking article rod making machine (20) by the use of a flexographic printing system (1). There is thereby obtained a better print quality at high making speeds with the associated advantage of use of water–based ink (12) instead of current oil–based inks.



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FLEXOGRAPHIC PRINTING ON SMOKING ARTICLE WEB MATERIAL

This invention relates to printing on smoking article wrapping material, such as tipping paper or cigarette paper.

It is a common problem that as the speed of cigarette machinery has increased, typically from about 3000 cigarettes per minute in the 1970's to about 14,000 cigarettes per minute in the late 1990's, there has not been a consequent increase in the print quality of web materials associated with the cigarette making industry. Indeed, print quality improvement has become a major project for many cigarette manufacturers and their machinery suppliers.

On most cigarette making machines, such as the Protos 100 made by Hauni (10,000 cig/min), the GD 121 (12,000 cigs/min) made by GD SpA, and the Sigma (8,000 cig/min) made by Sasib SpA, the printing system has been the letterpress printing system. A letterpress printing system typically uses an ink supply from ink ducts directed onto a rubber covered inking roller, which inking roller is contacted by one or more distribution rollers which increase the spread of the ink on the rubber inking roller across the surface of the roller and also smoothes out the ink on the surface of the inking roller. The distribution roller(s) usually reciprocate(s) axially in order to spread the ink over the surface of the inking roller. One of the distribution rollers then contacts a further rubber ink application roller

which has ink applied across the full surface thereof in an even manner. The ink is then applied to the raised indicia on the surface of a steel plate roller. Adjacent to and in contact with the plate roller is a compression roller. The web of material to be printed passes between the plate roller and the compression roller, and the raised ink indicia on the plate roller transfer ink onto the web material.

Typically the ink used in these systems is a viscous oil based ink which requires a period of working by the distribution rollers in order for it to become evenly distributed and reach a stable viscosity for efficient transfer to paper. This means that there is wastage of product when the machine is running but producing unacceptable product. Since ink viscosity and flow is a function of temperature, which fluctuates with time, the ink transfer characteristics also change with time, demanding continuous operator attention to maintain print quality. Furthermore, the oil based ink only dries by absorption into the paper. The fast moving environment of a cigarette making machine thus causes problems with oil-based inks in that the ink, when applied in excess, can transfer to other parts of the machine unintentionally and because it is slow drying there is enhanced propensity for contamination of a large amount of product. The viscosity of the ink causes build up of ink on some components, which is detrimental to machine performance.

The speed of the production in current cigarette making machines also causes significant wearing down of machine

parts and the steel etched plate rollers of letterpress systems are expensive to replace. The sharpness of the steel indicia on the plate rollers can also penetrate the thin web material if the pressure between the plate roller and rubber impression roller is too great. This affects product performance drastically. An alternative system for the plate roller surface is desirable to reduce running and replacement costs in this environment.

Whilst other printing systems than letterpress printing are known, such as intaglio printing, lithographic printing or flexographic printing, it is believed by Applicant that use of a flexographic printing system has not heretofore been proposed for a cigarette making machine. The reason for this is that most flexographic systems run at much slower speeds. For example, the envelope printing system of US Patent No. 5,088,407 runs slowly compared with a cigarette making machine, and label printers for pressure sensitive adhesive labels typically run at up to 200m/min, whilst the high speed web-fed flexographic printer of US Patent No. 5,413,041 for printing books runs at speeds up to 5m/sec (300m/min) compared with production speeds on cigarette makers of about 600m/min. To achieve high quality printing at such speeds has heretofore not been achieved with the printing systems currently supplied by GD Spa and Hauni, for example.

Flexographic printing is known as the printing system used for some newspapers where the speed of production is quite high and may be as fast as the speed required in the cigarette making industry, say 600m/min, but the printing

press system and rollers thereof are about 2 metres wide. In contrast, label printers using the flexographic system run at less than or equal to about 200m/min. The print rollers of these systems are normally about 150mm-300mm wide.

Whilst the label printing system is much smaller than the newspaper press system, the dimensions of the rollers of a flexographic system of a cigarette making machine would be even smaller still. A machine running single track paper width would require rollers up to 40mm wide, and advantageously 20-35mm wide, whilst a double track machine would require rollers that are 35-60mm wide, advantageously 45-55mm wide. The roller size will, however, to some extent depend on the size of the indicia to be transferred to the web material. To the best of our knowledge such a reduced dimension high-speed flexographic printing system has not yet been proposed or constructed, nor the efficacy of such a system tested. The closest prior art of which we are aware is US Patent No. 5,674,571 which describes a chambered, flexographic printing system using a screen roller and a transfer roller and a sealed chamber for ink supply to the screen roller. It is our experience that the pressure required to supply ink in such chambered systems causes ink leakages at the operating speeds we require.

This invention puts into practice a new printing system for smoking article processes associated with making, which machine overcomes a number of disadvantages of current printing systems, such as improved print quality, even at

high speeds, reduced product contamination, use of preferred inks, and easier cleaning and maintenance of such systems.

It is an object of the invention to provide a cigarette web material printing system which provides an improved quality of printing over prior art cigarette web material printing systems. In particular, it is an object to overcome the denuding of the ink supply over some portions of an indicia, which portions have a greater amount of raised indicia region than other portions of the indicia.

It is a further object of the invention to provide a cigarette web material printing system which has a readily replaceable surface on the print roller.

It is a further object of the invention to reduce the contamination of other machinery parts or material.

It is a further object of the invention to provide a cigarette web material printing system which utilises an ink which is more suitable for the fast moving cigarette manufacturing environment.

The present invention provides a smoking article rod making machine, said machine further comprising a flexographic printing system arranged to print indicia onto cigarette wrapping material fed to said making machine.

Preferably the flexographic printing system comprises ink supply means mounted parallel with and adjacent to ink transfer means, the ink transfer means being mounted parallel with and adjacent to indicia forming means, bearing means being mounted parallel with and adjacent to the indicia

forming means, and a web material path being provided between the bearing means and the indicia forming means.

Preferably the ink supply means is disposed within a water-based ink supply source. Even more preferably the ink supply means is driven by an independent drive means or drive means common with the drive means of the ink transfer means and indicia forming means but being adapted to drive the ink supply means at a lower speed than the speed of the common drive means. Advantageously the speed of the ink supply means is in the range of 20-2000rpm, more advantageously is in the range of 500-1000rpm, and even more advantageously is at or about 750rpm. However, the speed of the ink supply means is dependent on the gap setting between the ink transfer means and the ink supply means, and the speed of the machine.

Preferably the ink transfer roller is an anilox roller having a surface volume provided by depressions. Advantageously the depressions are of a size within the range of 5-40μ, and provide a surface volume within the range of 3-12cc/m^2. Suitably the anilox roller comprises a metal drum covered with a ceramic or other embossed or engraved surface.

Preferably the indicia forming means comprises a plate cylinder being a metal drum adapted to carry image forming means. Advantageously the image forming means is releasably securable image forming means. The image forming means may comprise a spring steel backing strip to which is attached a thin plastic die strip having raised indicia markings, and the spring steel backing strip may be provided with

releasable ends adapted for engagement with releasable securing means. The releasable securing means may suitably be an eccentric knurled roller seated below the surface of the metal drum or, alternatively, double-sided adhesive tape sticky enough to withstand the centrifugal force exerted on the image forming means during rotation of the metal drum. Alternatively, a plastic die strip may be used instead of the steel backing strip with attached plastic strip. A further alternative is the use of an indicia or image forming means which may be secured in place by means of a removable sleeve system.

Preferably the plastic die strip is composed of relatively soft plastic material, such as rubber or a photopolymer.

Preferably the bearing means is a resilient bearing means comprising a rubber or rubber-surfaced roller, or a non-resilient bearing means, such as a metal roller. The roller may additionally be spring-loaded.

Preferably the ink transfer means and the indicia forming means are driven by common drive means, which drive means is advantageously the drive means of the smoking article making machine. Advantageously the ink transfer means and the indicia forming means are driven at a speed within the range 100 to 4000rpm, more preferably 1500-3000rpm, and even more preferably at about 2,500rpm. The surface speed of these rollers should be substantially equivalent to the speed of the web material.

Preferably the ratio of the speeds of the drive means of the ink transfer means and of the ink supply means is in the range of 1:1 - 10:1, and preferably is in the range of 3:1 to 5:1.

Suitably the ink supply means and the ink transfer means are driven in counter-direction, although they may both be driven in the same direction.

Advantageously located downstream of the resilient bearing means and indicia forming means in the web material path there is provided web driving means, the web driving means suitably being a pair of driven nip rollers.

Advantageously the ink supply source comprises ink inlet and outlet flow means for providing a constant level of ink in the ink supply source.

Preferably the ink supply source comprises an ink level monitoring device for providing a constant level of ink in the ink supply source.

Preferably mounted within the ink supply source is excess ink removal means. Advantageously the excess ink removal means is a reverse angle doctor blade assembly, which may comprise a doctor blade, a holder therefor, a pivot and a biased sprung steel spring. The end of the doctor blade adjacent the anilox roller may be metal or plastic.

In order that the invention may be easily understood and readily carried into effect, reference will now be made, by way of example, to the following diagrammatic drawings in which:

Figure 1 shows in longitudinal cross-section a flexographic print system mounted on a smoking article making machine in accordance with the present invention,

Figure 2 shows a digital reproduction of a photo-micrograph of an image produced according to a prior art letterpress sytem, and

Figure 3 shows a digital reproduction of a photo-micrgraph of an image produced according to the invention.

Figure 1 of the diagrammatic drawings hereof show a flexographic printing system 1 which is mounted on part 20 of a smoking article making machine in accordance with the present invention. The printing system comprises a non-resilient bearing means being an impression roller 2 having a metal surface. The impression roller 2 is arranged to rotate in a first direction, anti-clockwise, for example, which direction is the direction of transport of cigarette wrapping material 3, which material in this instance is a paper web material. The impression roller 2 serves as a bearing surface onto which the die for an indicia is pressed against the material 3. Mounted parallel to the impression roller 2 and disposed adjacent the impression roller 2 is indicia forming means being a plate cylinder 4. The plate cylinder 4 comprises a 19mm wide metal drum which is adapted to provide a clip-receiving area 5 into which can be inserted a releasable clip 6 of spring steel. The releasable clip 6 forms a backing strip around the drum and is connected to a plastic die strip 7 to provide releasably securable image forming means which has on its surface one or more raised

markings for the required indicia to be applied to the cigarette web material. Four relief indicia are provided on the plastic die strip 7. The number of images depends on the circumference of the roller, which is a multiple of the length of one cigarette. The plastic die strip 7 covers about 2/3 of the full width of the surface of the plate cylinder 4. The remaining end of the plastic die strip 7 is also retainable in or close to the clip receiving area 5 of the plate cylinder 4 in order to releasably secure the plastic die strip 7 to the plate cylinder. Alternatively, a plastic die strip 7 may be held within a locating groove by an industrial strength double-sided adhesive tape which is sticky enough to withstand the centrifugal force generated upon rotation. Advantages of the releasable die strip are ease of removal when the die indicia wear down because of speed of operation, reduced operating cost instead of using an etched metal plate cylinder. Furthermore, the plastic die strip 7 is less aggressive in its action upon the web material than an etched steel die, which steel die can easily cut a thin, paper web material, for example. The plate cylinder 4 rotates in the opposite direction to the impression roller, i.e. in a clockwise direction, for example, as shown by the arrow in Figure 1. Located downstream of the direction of travel of the cigarette wrapping material 3 are wrapper material drive means, such as a pair of driven nip rollers 8 which draw the cigarette wrapping material between impression roller 2 and plate

cylinder 4. Impression roller 2 is thus caused to rotate by the web material itself, in combination with nip rollers 8.

Mounted parallel and adjacent to plate cylinder 4 is an ink transfer means, anilox roller 9. Anilox roller 9 is arranged to rotate in the same first direction as impression roller 2, i.e. anti-clockwise in the direction of the arrow. Anilox roller 9 comprises a 40mm wide steel drum on which is coated a ceramic surface. The ceramic surface has formed therein, by for example, laser treatment, small depressions or dimples on a μ scale. The depressions are of the order of 5-40μ in size. The dimpled surface of the anilox roller gives good holding and transfer of ink to the plate cylinder 4. The size or surface volume of the dimples is selected in accordance with the amount of ink which is desired to be transferred to the plate cylinder and thence to the cigarette wrapping material 3, as well as the depth of colour required. As an alternative to having exactly the preferred surface volume on the anilox roller, the amount of pigment in the ink can be controlled to darken the colour. It is important that there is good contact between the plastic die strip 7 of plate cylinder 4 and the anilox roller 9, so the gap between these two rollers is important, along with the amount of ink held in the dimples of the anilox roller 9. Furthermore, the hardness or softness of the plastic die strip 7 also determines the amount of ink transferred thereto. Plate cylinder 4 and anilox roller 9 are driven by a common motor. The speed of rotation of each roller will depend on the size of each roller but each will have the same surface speed as

the speed of the web material. The drive means motor may be the motor of making machine 1 or a motor driven at the same speed as making machine 1. Gearing means or clutch means may be provided to enable the anilox roller 9 to continue rolling during machine down time in order to prevent the ink from drying or setting on the roller 9.

Disposed below the anilox roller 9 is ink supply means, such as an ink application roller 10. Ink application roller 10 is also mounted parallel to and adjacent anilox roller 9. Ink application roller 10 is driven independently of anilox roller 9 and plate cylinder 4 and at a slower speed than those rollers. The speed of anilox roller 9 and plate cylinder 4 is about 2,500rpm. The speed of ink application roller 10 is about 750rpm. The ink application roller 10 is disposed at least partly extending into an ink reservoir 11 containing a water-based liquid ink 12. The speed of the motor driving ink application roller 10 should be just fast enough to provide an excess of ink to fill the dimples or cells of the anilox roller 9 and to fill the nip gap between the anilox roller 9 and the ink application roller 10. If the speed of the ink application roller 10 is too slow there will be ink starvation in the supply to the plate cylinder 4. Conversely, if the speed of the ink application roller is too fast this will cause turbulence in the ink reservoir, foaming or spraying up of the ink, and/or incomplete filling of the dimples in the anilox roller, which may also cause ink starvation, as well as contamination or 'set off' from the overspill of ink to other areas of the machine.

The ink reservoir 11 may comprise an ink level monitoring device which may be linked to an ink supply source via a line (not shown) to the ink reservoir 11. Alternatively, ink is continually supplied to the ink reservoir 11 through inlet opening 18 and ink continually flows out of the ink reservoir 11 through outlet opening 19 to provide a constant level of ink 12.

Located adjacent the anilox roller 9 is a reverse angle doctor blade assembly 13, one end of which assembly is disposed at a tangent to the surface of the anilox roller 9. A doctor blade 14 is inclined at an acute angle to the roller surface which causes excess ink to be lifted off the anilox roller surface and dropped back into the ink 12 in the ink reservoir 11. The second end of the doctor blade is a sprung steel spring 15 which lies against the side of the ink reservoir 11 under compression or tension between pivot point 16, the ink reservoir side wall and the anilox roller surface. The end of doctor blade 14 against the surface of the anilox roller 9 is plastic to reduce wear on the surface of the anilox roller 9. The doctor blade is held in a holder clamp 17, which clamp is also attached to spring steel spring 15. The arrangement of the doctor blade assembly 13 also provides an ink containment region to reduce ink splashing and contamination.

In operation of this system a surplus of water-based ink is picked up by the ink application roller 10 and distributed to the nip region between the anilox roller 9 and the ink application roller 10. The surface volume of the anilox

roller dimples accepts and distributes the surplus ink at the nip across with width of the anilox roller 9. Any excess ink is removed by the reverse angle doctor blade and returned by gravity to the ink 12 in the ink reservoir 11. The correct amount of ink is supplied from the dimples of the anilox roller 9 to the relief indicia of the plastic die strip 7, which ink is in turn transferred to the cigarette web material as the paper web 3 passes between the impression roller 2 and plate cylinder 4.

Previous letterpress systems currently available on some machines, such as the Protos 100 or Sasib Sigma, have shown that a considerable decrease in print quality occurs when the machines run at speeds greater than 8,000 cigarettes per minute (for a single track machine). In contrast, the flexographic based printing system of the invention provides good quality printing of indicia at such speeds or even higher.

By way of quantitative representation of the improvement in print quality a single enlarged image of part of a brand trademark was scanned at 600dpi (about 42μ resolution) using an image analyser. A theoretical outline area for the image is measured in square pixels, this being the area within the figure without any ink loss. This ink coverage was measured for an image generated using the current letterpress technology on a Protos machine (see Figure 2) and on the same machine with the alternative printing system of the present invention (see Figure 3). The letterpress image has ragged edges and voids, and some parts of the image were completely

separated from each other. This required the scanned image to be processed some more to generate a theoretical outline. In contrast, for the image produced using the inventive system the edges of the image were much clearer, i.e. more well-defined, and any loss in colour was due to very much smaller void areas. Consequently, in view of the better image the number of square pixels is increased over the area covered by the letterpress system. The actual area is the area covered by ink within the theoretical outline area. It can be seen from the figures in Table I that compared with the theoretical outline area the deficiency in print quality for the letterpress system is nearly 20%, whereas for the inventive system, at the same speed, the deficiency is <1%.

Table I

	Letterpress system	**Inventive system**
Theoretical outline area	544982	577014
Actual area	437550	572342
Reduction	107432	4672
% Reduction	19.71%	0.81%

(Area measurements in square pixels)

Use of the flexographic based system on a smoking article making machine overcomes many of the problems previously experienced using letterpress technology. The water-based ink which one can use with flexographic printers is quick to penetrate into the cigarette wrapping material, for example, so driers are not necessarily required and the clarity of the print margins are improved because of better absorbency of the ink. There is reduced 'set off' of ink because the ink dries more quickly, even when the weight of ink pigment is increased to increase print intensity, unlike with oil based inks. Cleaning of machinery is also easier, less messy and less problematical and there is no problem with disposal of solvent cleaning fluids, as with oil based inks. Furthermore, the ink is distributed better across the whole image area because of the use of an anilox roller and low viscosity inks. In particular, the ink on the image indicia is renewed on the anilox roller at every rotation of the plate cylinder, unlike the letterpress system where the inking roller is replenished inefficiently at high speeds.

CLAIMS

1. A smoking article rod making machine, said machine further comprising a flexographic printing system arranged to print indicia onto cigarette wrapping material fed to said making machine.

2. A smoking article rod making machine according to Claim 1, wherein said flexographic printing system comprises ink supply means mounted parallel with and adjacent to ink transfer means, the ink transfer means being mounted parallel with and adjacent to indicia forming means, bearing means being mounted parallel with and adjacent to the indicia forming means, and a web material path being provided between the bearing means and the indicia forming means.

3. A smoking article making machine according to Claim 2, wherein said ink supply means is disposed within a water-based ink supply source.

4. A smoking article rod making machine according to Claim 2 or 3, wherein said ink supply means is driven by an independent drive means or drive means common with the drive means of the ink transfer means and indicia forming means but being adapted to drive the ink supply means at a lower speed than the speed of the common drive means.

5. A smoking article rod making machine according to any one of Claims 2 to 4, wherein the speed of the ink supply means is in the range of 20-2000 rpm.

6. A smoking article rod making machine according to Claim 5, wherein the speed of the ink supply means is in the range of 500-1000 rpm.

7. A smoking article rod making machine according to any of Claims 2 to 6, wherein said ink transfer roller is an anilox roller having a surface volume provided by depressions.

8. A smoking article rod making machine according to Claim 7, wherein the surface volume of said ink transfer roller is within the range of 3-12 cc/m^2.

9. A smoking article rod making machine according to any one of Claims 2 to 8, wherein said indicia forming means comprises a plate cylinder being a metal drum adapted to carry image forming means.

10. A smoking article rod making machine according to Claim 9, wherein said image forming means is releasably securable image forming means.

11. A smoking article rod making machine according to Claims 9 or 10, wherein said image forming means comprises a spring steel backing strip to which is attached a thin plastic die strip having raised indicia markings.

12. A smoking article rod making machine according to Claim 9 or 10, wherein said image forming means is a plastic die strip.

13. A smoking article rod making machine according to Claim 9 or 10, wherein said indicia forming means or image forming means is secured in place by means of a removable sleeve system.

14. A smoking article rod making machine according to Claims 11 or 12, wherein said plastic die strip is composed of soft plastic material.

15. A smoking article rod making machine according to any one of Claims 2 to 14, wherein said bearing means is a resilient bearing means.

16. A smoking article rod making machine according to any one of Claims 2 to 15, wherein said ink transfer means and said indicia driving means are driven by common drive means.

17. A smoking article rod making machine according to Claim 16, wherein said drive means is advantageously the drive means of the smoking article making machine.

18. A smoking article rod making machine according to Claim 16 or 17, wherein said ink transfer means and said indicia forming means are driven at a speed within the range of 100-4000 rpm.

19. A smoking article rod making machine according to any one of Claims 2 to 18, wherein the ratio of the speeds of the drive means of said ink transfer means and of the ink supply means is in the range of 1:1 to 10:1.

20. A smoking article rod making machine according to any one of Claims 2 to 19, wherein said ink supply source comprises an ink level monitoring device for providing a constant level of ink in said ink supply source.

21. A smoking article rod making machine according to any one of Claims 2 to 19, wherein said ink supply source has mounted therewithin excess ink removal means.

22. A smoking article rod making machine substantially as hereinabove described with reference to Figure 1 of the diagrammatic drawings hereof.

Fig.1.

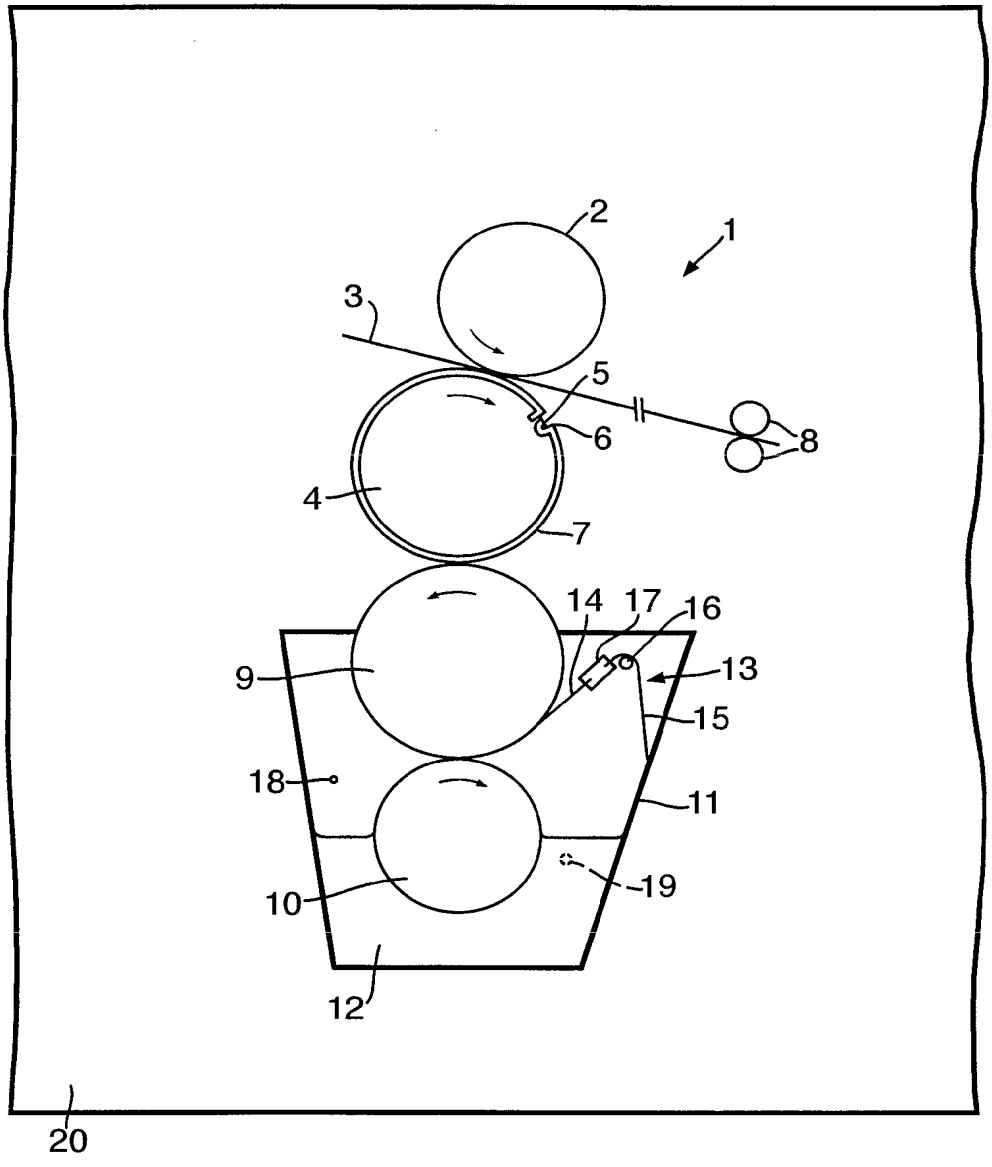

Fig.2.

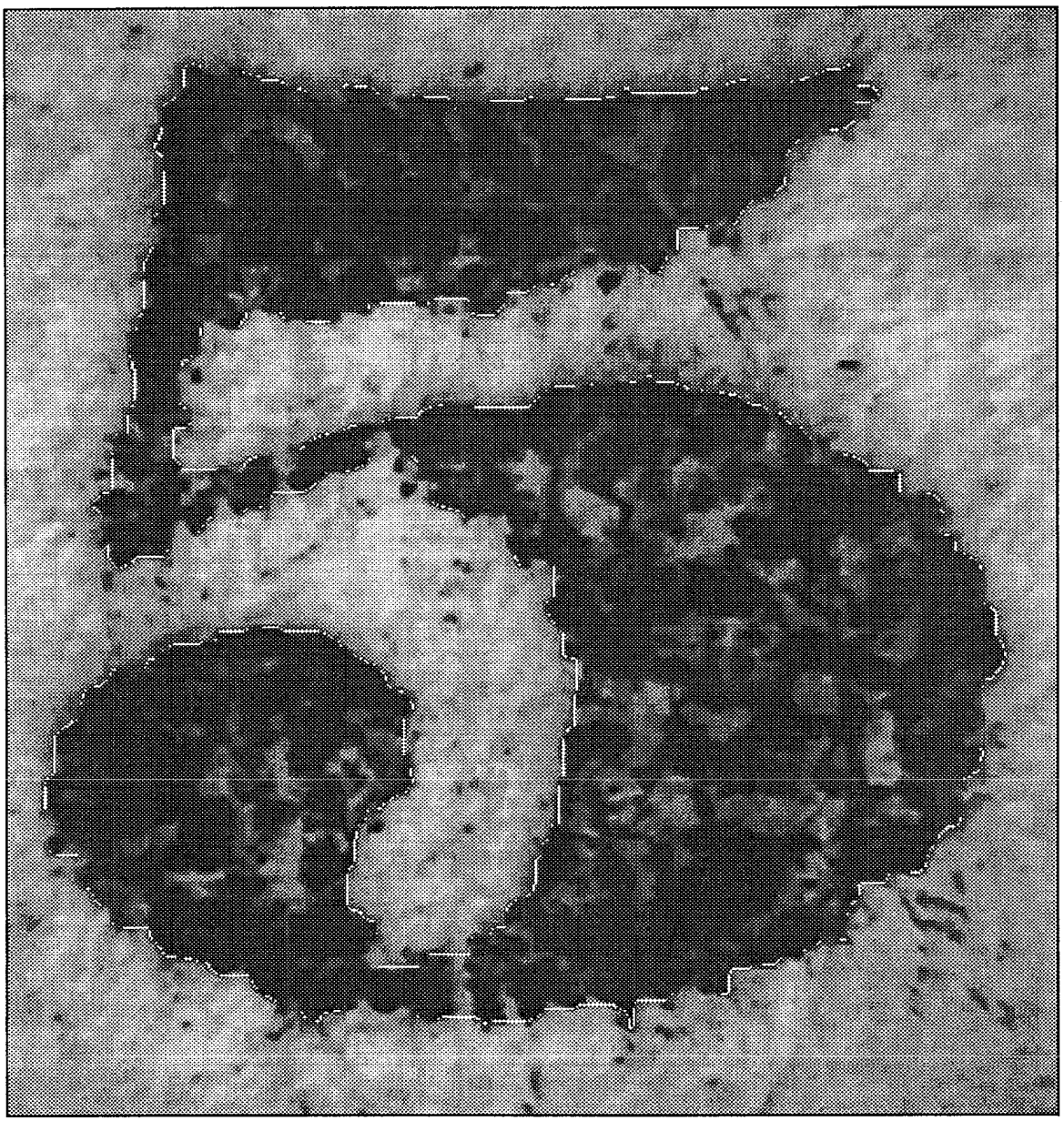

Fig.3.

INTERNATIONAL SEARCH REPORT

Int .tional Application No
PCT/GB 99/01036

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B41F5/24 A24C5/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B41F A24C B41K B41L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 249 587 A (MARSHALL C. LUCKADO) 5 October 1993 (1993-10-05) see abstract column 1, line 6 - column 4, line 6; figures 1-4	1-21
Y	EP 0 523 567 A (MICHAEL HUBER MÜNCHEN GMBH) 20 January 1993 (1993-01-20) page 1, line 1 - page 4, line 9; claims 1,13	1-21
Y	GB 2 184 064 A (MOLINS PLC) 17 June 1987 (1987-06-17) see abstract page 1, line 5 - page 2, line 13; figures 1,2	4,15

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 July 1999	02/08/1999

Name and mailing address of the ISA	Authorized officer
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